Test-Report

Electro Products & Telecom Systems Laboratories

Subject	:	3M QS 1000 Inline Splice 92-AG 620-3 (ADWEA) in Cold Shrink Technology for 3 core plastic insulated copper wire/tape screened armoured cables 6.35/11 (12) kV
Type of Test	:	Type Test 6.35/11 (12) kV, Test Sequence II B1 Additional tests
Specifications	:	According to CENELEC HD 628 and HD 629.1
Date of Test	:	February 12th, 2002 - May 9st, 2002
Test Summary	:	The 3M QS 1000 Inline Splice 92-AG 620-3 (ADWEA) passed the Type Test according to CENELEC and the additional tests successfully.
Date	:	June 14th, 2002

Albrecht Ott
Electrical Products

Jens Weichold
Test Services

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VAT-ID-No.: DE 120679179

1. Description of Samples

One 3 core test loop of about 6 m length was prepared according to the attached installation instructions (drawing no. XE 0091-2647-7).

Cable	:	RIYADH CABLES AND METALS ELECTRIC CABLE 11 000 VOLTS 3 x 185/110 MM2 CU/XLPE/DSTA/PVC 2000 PROPERTY OF ADWEA UAE 3 core plastic insulated copper tape/wire screened armoured cable
Splice	:	3M QS 1000 Inline Splice 92-AG 620-3 (ADWEA)
Termination	:	3M Quick Termination II Type 92-EB 64-4 ME

2. Test Sequence

Test	Type of Test according to HD 629.1 sequence Table 3 , A1 6.35/11 kV (12) kV	Section of HD 628
2.1	DC Voltage Dry Withstand Test 15 minutes at 6xUo = 38 kV	5
2.2	AC Voltage Dry Withstand Test 5 minutes at 4,5xUo = 28,5 kV	4
2.3	Partial Discharge Test at ambient temperature max. 10 pC at 11 kV	7
2.4	Impact Test at ambient temperature Insulation resistance > 50 MΩ	14
2.5	Impulse Voltage Withstand Test at ambient temperature 1.2 / 50 µs 10 x ± 95 kV	6
2.6	Electrical Heat Cycling in air , 3cycles 16 kV/3x511 A in-phase 5h/3h , $\vartheta_{conductor}$ = (90+5)°C	9
2.7	Partial Discharge Test at elevated and ambient temperature 5h/3x511 A in-phase , $\vartheta_{conductor}$ = (90+5)°C max. 10 pC at 11 kV	7
2.8	Electrical Heat Cycling in air , 60 cycles , 16 kV/3x511 A in-phase 5h/3h , $\vartheta_{conductor}$ = (90+5)°C	9
2.9	Electrical Heat Cycling in water , 63 cycles , 16 kV/3x511 A in-phase 5h/3h , $\vartheta_{conductor}$ = (90+5)°C	9
2.10	Partial Discharge Test at elevated and ambient temperature 5h/3x511A in-phase , $\vartheta_{conductor}$ = (90+5)°C max. 10 pC at 11 kV	7
2.11	Impulse Voltage Withstand Test at ambient temperature 10x ± 95 kV after 8 h heating with 3x511A in-phase	
2.12	AC Voltage Dry Withstand Test 15 minutes at 2,5xUo = 16 kV	4
	Additional tests requested by customer	
2.13	Impact Test at ambient temperature with 3 m falling height Insulation resistance > 50 MΩ	
2.14	AC Voltage Dry Withstand Test 15 minutes at 2,5xUo = 16 kV	4

Witnessing

Tests no.2.1 to 2.5 were witnessed by ADWEA Representatives:
Eng. Ghazi Izzat Mari
Eng. Muotasem M. Abbasi
Eng. Jawdat Kaddoura
Tests no. 2.9 (last cycle) to 2.14 were witnessed by ADWEA Representative
Eng. Ghazi Izzat Mari

2.1 DC Voltage Dry Withstand Test

A DC voltage of -38 kV was applied to each phase for 15 minutes while the screen was connected to earth potential. The test was made in air at ambient temperature.

Requirement : no breakdown or flashover

	at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	-38 kVDC/15 min.	passed
2	-38 kVDC/15 min.	passed
3	-38 kVDC/15 min.	passed

Used Equipment : 3M No. 71 745

2.2 AC Voltage Dry Withstand Test

For each phase the voltage was increased from 0 to 28,5 kV and maintained for 5 minutes. The screen was connected to earth potential. The test was made in air at ambient temperature.

Requirement : no breakdown or flashover

	at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	28,5 kVAC/5 min.	passed
2	28,5 kVAC/5 min.	passed
3	28,5 kVAC/5 min.	passed

Used Equipment : 3M No. 71 745

2.3 Partial Discharge Test at ambient temperature

For each phase the voltage was increased from 0 to 13,2 kV and maintained for 1 minute. Then the voltage was decreased to 11 kV and the partial discharge level (PD) was recorded within 1 minute. The screen was connected to earth potential. The test was made in air at ambient temperature.

Requirement : PD magnitude must not exceed 10 pC at 15 kV

	PD at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC
2	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC
3	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC

Used Equipment : 3M No. 115 258

2.4 Impact Test at ambient temperature

Prior to impacting, the insulation resistance was measured between the conductors and the metallic screen/sheath with a measuring voltage of 500 V DC.

The splices were placed in a supporting bed of sand directly on a concrete floor. A wedge shaped block of a mass of 4 kg having a 90° angle with a 2 mm radius impacting edge was dropped freely from a height of 1.0 m onto the joint. The edge hit the joint horizontally and at right angles to the axis of the joint. One impact was applied at each end (metallic sheath cut back) of the splice and one at the center over the connectors

Afterwards the loops were put back into the water bath and left for 24 h prior to the final resistance measurement.

Requirement : Insulation resistance between conductors and metallic screen > 50 mΩ

	Resistance at ambient temperature ϑ_a = 23°C	
Phase to screen	Prior impact	After impact
1	> 10 000 MΩ	> 10 000 MΩ
2	> 10 000 MΩ	> 10 000 MΩ
3	> 10 000 MΩ	> 10 000 MΩ

2.5 Impulse Voltage Withstand Test at ambient temperature

All phases together were subjected to 10 positive and 10 negative voltage impulses (waveform :1.2 / 50 µs) with peak values of 95 kV between conductor and screen, while the screen was connected to earth potential. The test was made in air at ambient temperature. Prior to the tests with positive and negative polarity, all phases were exposed once to 50 %, 65 % and 80 % of the nominal impulse voltage.

Requirement : no breakdown or flashover

1.2/50 µs	at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	10 x ± 95 kV	passed
2	10 x ± 95 kV	passed
3	10 x ± 95 kV	passed

Used Equipment : 3M No. 71 744

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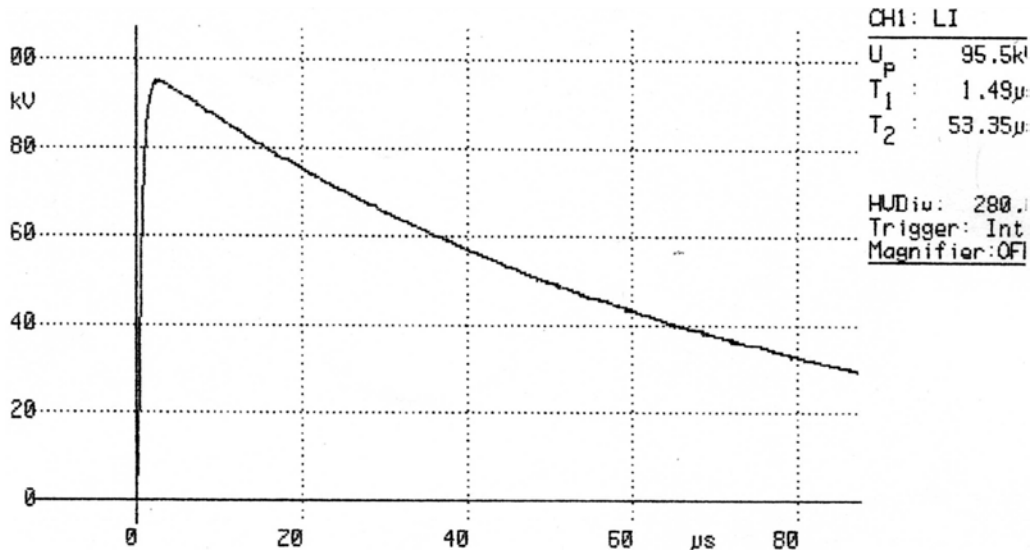
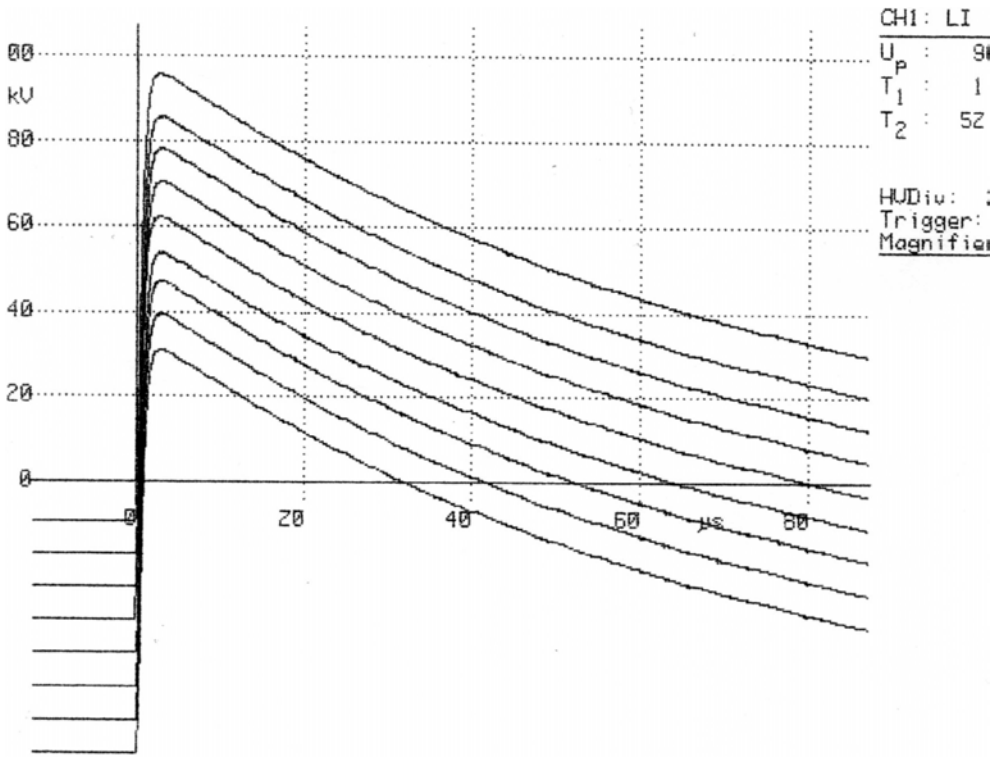
Positive impulses (all phases together)





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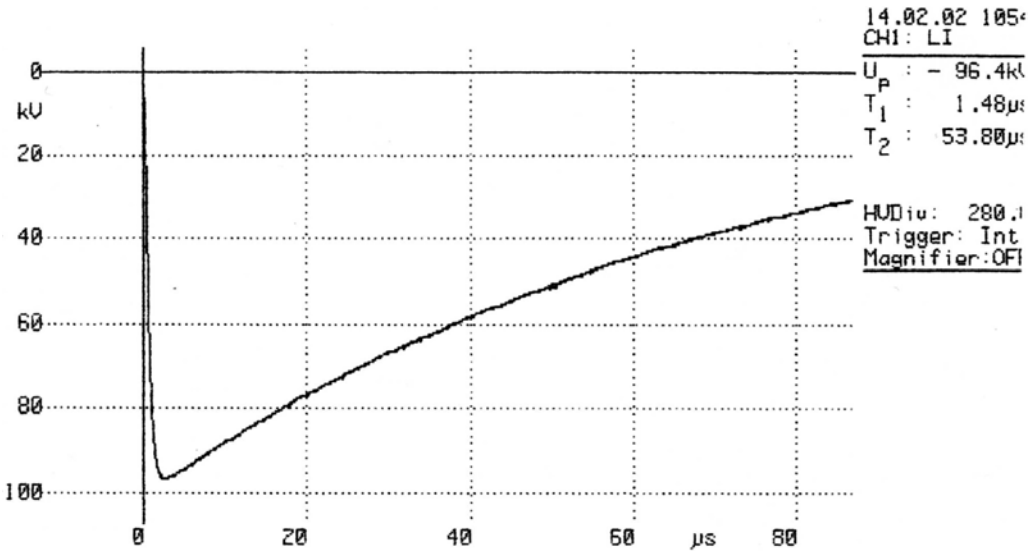
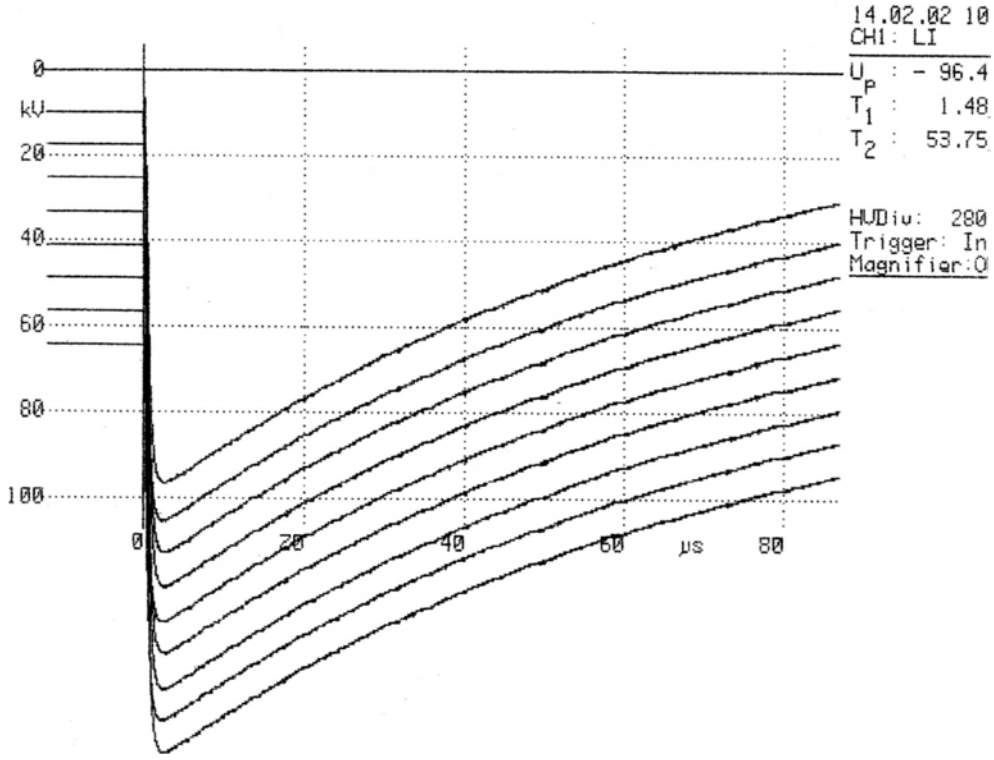
Negative impulses (all phases together)





2.6 Electrical Heat Cycling in air

An AC voltage of 16 kV was applied between phases and screen for 3 cycles. Each cycle consisted of a 5 h heating period and a 3 h cooling period. During the heating periods the conductors were heated up to a temperature of (90 + 5)°C by a current of 511 A. The cycles were conducted in air at ambient temperature.

Requirement : no breakdown or flashover

3 cycles 5h/3h	$\vartheta_{conductor}$ = (90+5)°C	
Phase	conditions	result
1	16 kV/511 A	passed
2	16 kV/511 A	passed
3	16 kV/511 A	passed

Used Equipment : 3M No. 71 747

2.7 Partial Discharge Test at elevated and ambient temperature

The cable conductors of the test loop were heated 3h and stabilized for at least 2h at a temperature of (90+5)°C by a heat current of 511 A. In the end of the heating period the voltage was increased from 0 to 13,2 kV and maintained for 1 minute. Then the voltage was decreased to 11 kV and the partial discharge level (PD) was recorded within 1 minute. After cooling down of the test loop the partial discharge level (PD) was recorded again. The screen was connected to earth potential. The test was made in air at ambient temperature.

Requirement : PD magnitude must not exceed 10 pC at 11 kV

	PD at elevated temperature $\vartheta_{conductor}$ = (90+5)°C	
Phase	conditions	result
1	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC
2	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC
3	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC

	PD at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC
2	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC
3	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC

Used Equipment : 3M No. 115 258

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2.8 Electrical Heat Cycling in air

Conducted under equal conditions and requirements as described under 2.6, but 60 cycles.

Requirement : no breakdown or flashover

60 cycles 5h/3h	$\vartheta_{conductor}$ = (90+5)°C	
Phase	conditions	result
1	16 kV/511 A	passed
2	16 kV/511 A	passed
3	16 kV/511 A	passed

Used Equipment : 3M No. 71 747

2.9 Electrical Heat Cycling in water

Conducted under equal conditions and requirements as described under 2.6, but 63 cycles in water bath with a level of 1m .

Requirement : no breakdown

63 cycles 5h/3h	$\vartheta_{conductor}$ = (90+5)°C	
Phase	conditions	result
1	16 kV/511 A	passed
2	16 kV/511 A	passed
3	16 kV/511 A	passed

Used Equipment : 3M No. 71 747

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2.10 Partial Discharge Test at elevated and ambient temperature

Conducted under equal conditions and requirements as described under 2.7 .

Requirement : PD magnitude must not exceed 10 pC at 11 kV

	PD at elevated temperature $\vartheta_{conductor}$ = (90+5)°C	
Phase	conditions	result
1	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC
2	13,2 kV/1 min.→11 kV/1 min	PD = 1,5 pC
3	13,2 kV/1 min.→11 kV/1 min	PD = 1,5 pC

	PD at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	13,2 kV/1 min.→11 kV/1 min	PD = 4 pC
2	13,2 kV/1 min.→11 kV/1 min	PD = 2 pC
3	13,2 kV/1 min.→11 kV/1 min	PD < 1 pC

Used Equipment : 3M No. 115 258

2.11 Impulse Voltage Withstand Test at ambient temperature

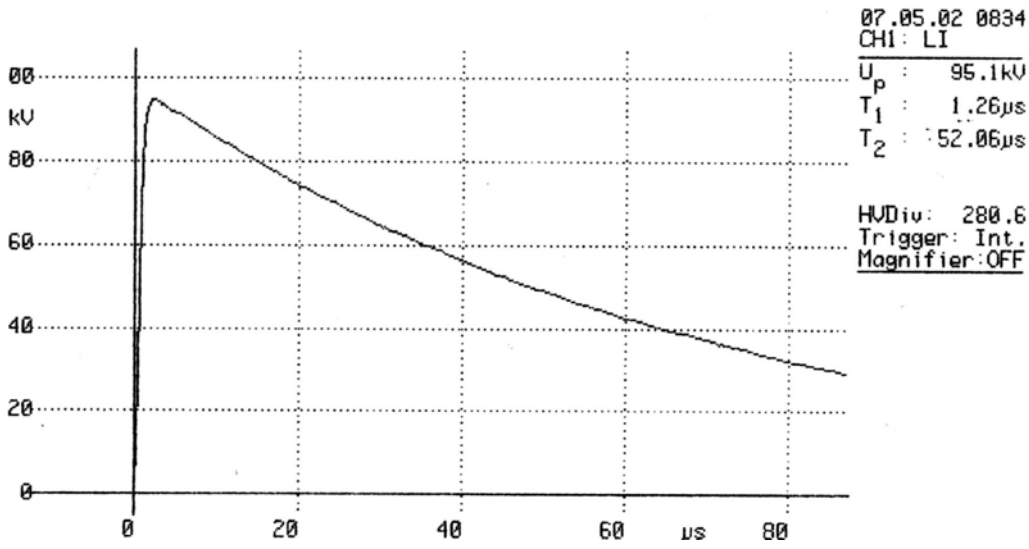
Each phase was subjected to 10 positive and 10 negative voltage impulses (waveform :1.2 / 50 µs) with peak values of 95 kV between conductor and screen, while the screen was connected to earth potential. The test was made in air at ambient temperature.

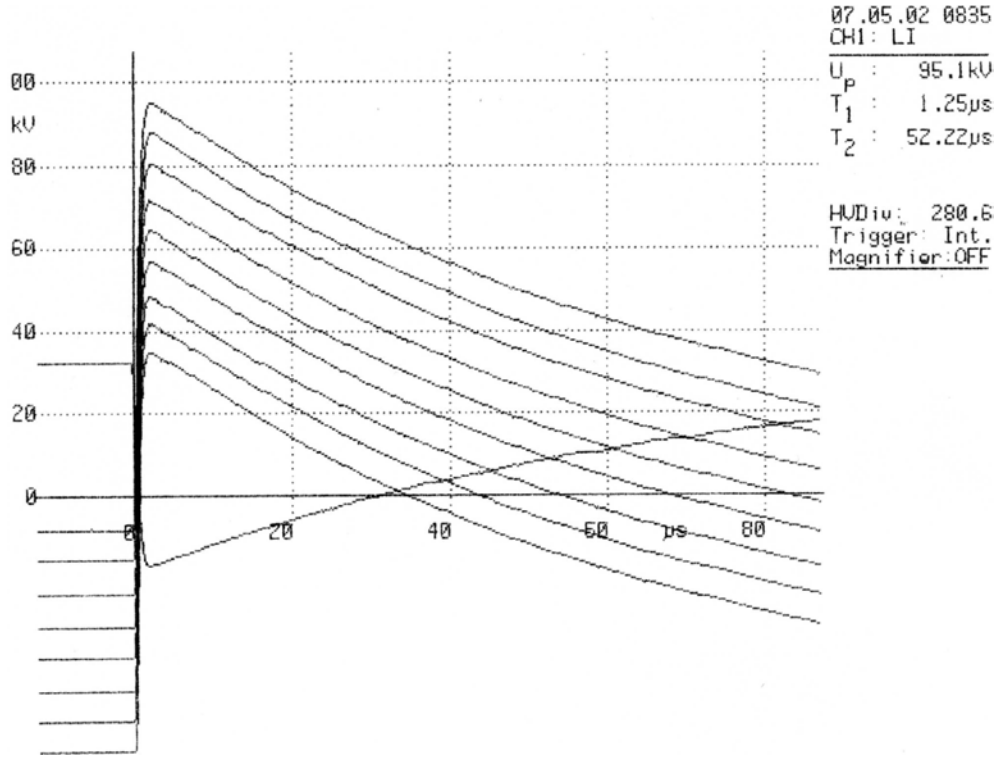
Requirement : no breakdown or flashover

1.2/50 µs	at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	10 x ± 95 kV	passed
2	10 x ± 95 kV	passed
3	10 x ± 95 kV	passed

Used Equipment : 3M No. 71 744

Phase 1 positive impulses





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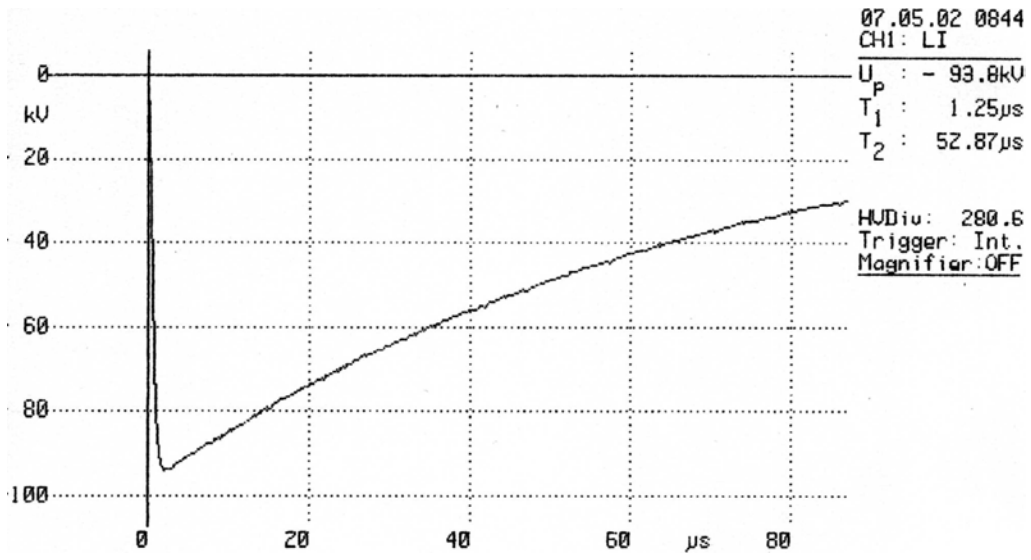
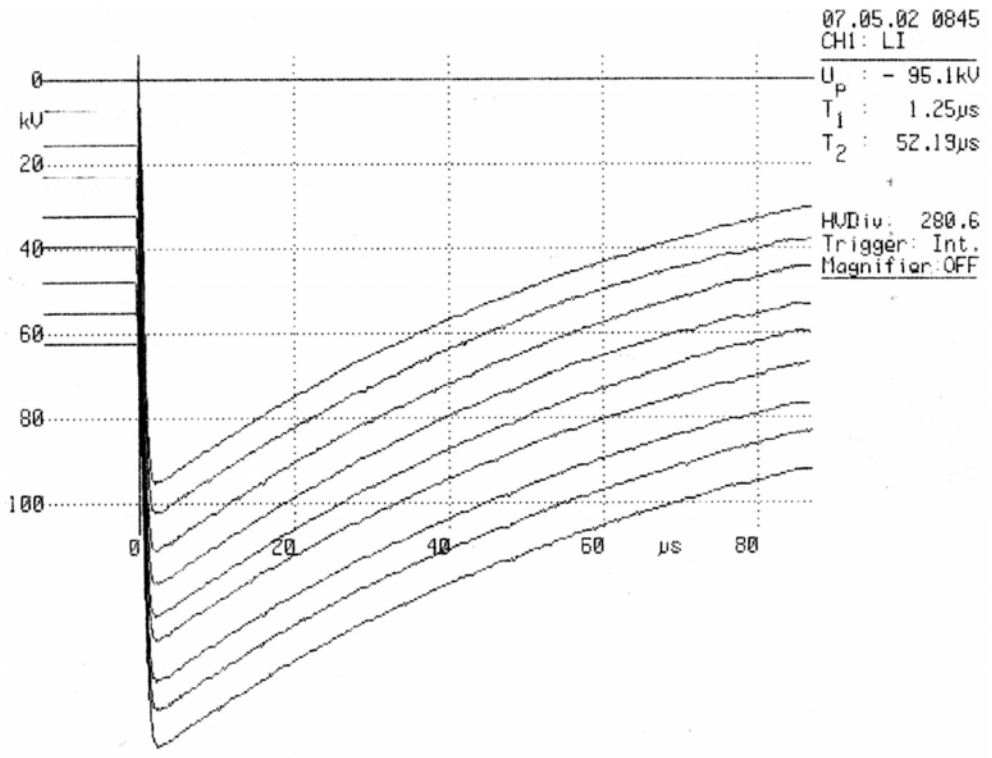
Phase 2 negative impulses





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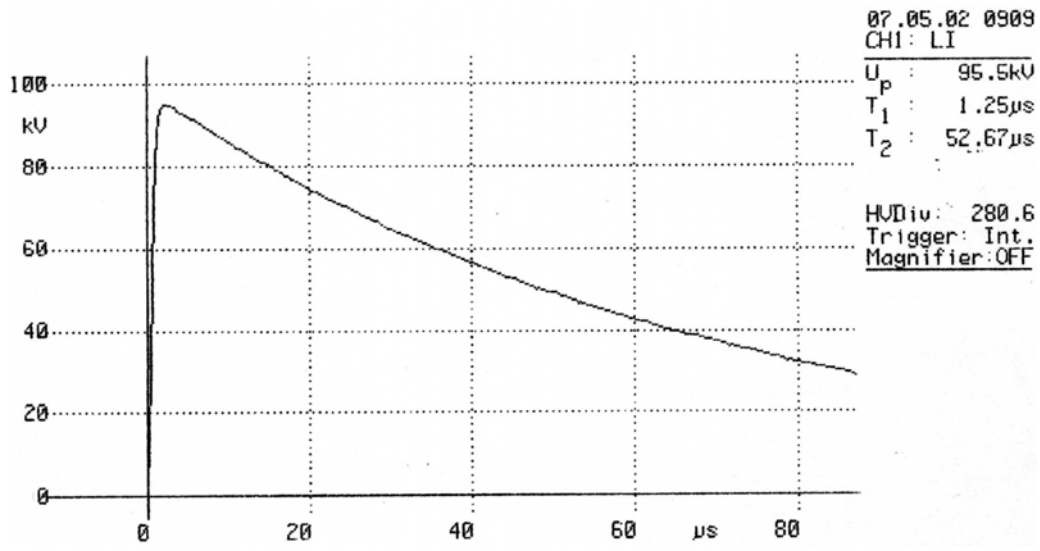
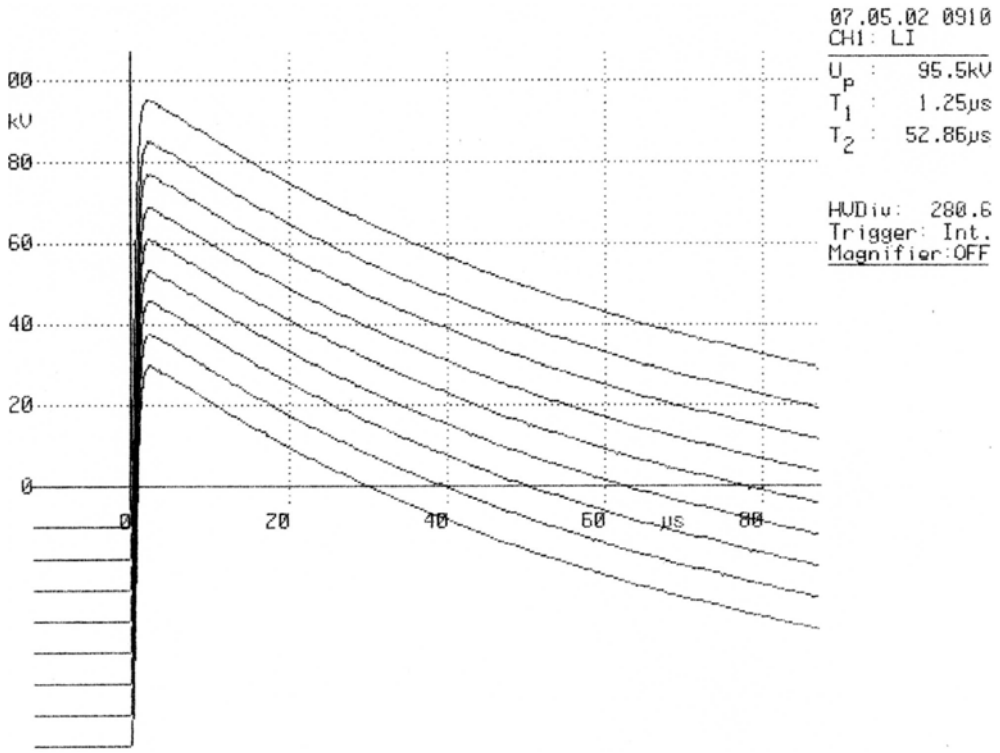
Phase 2 positive impulses





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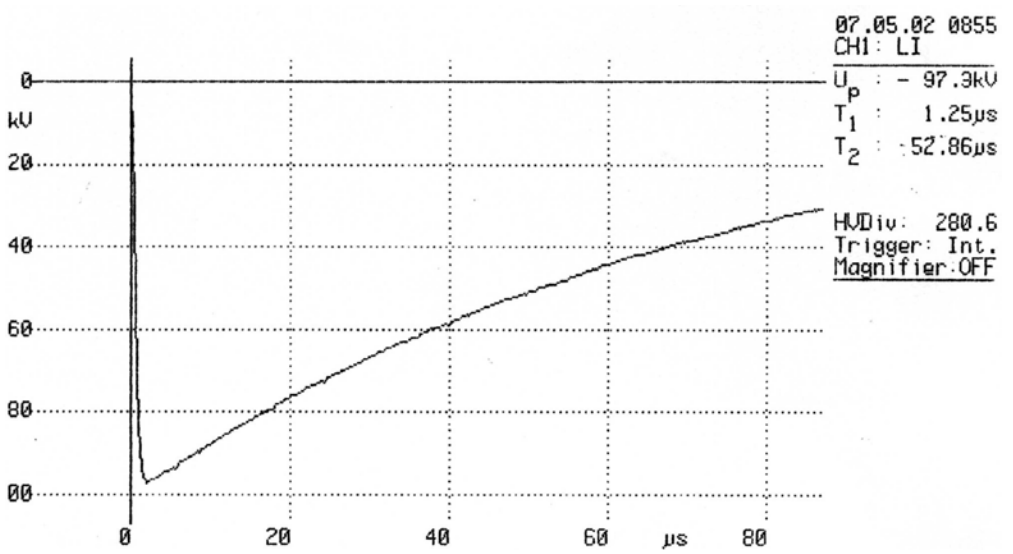
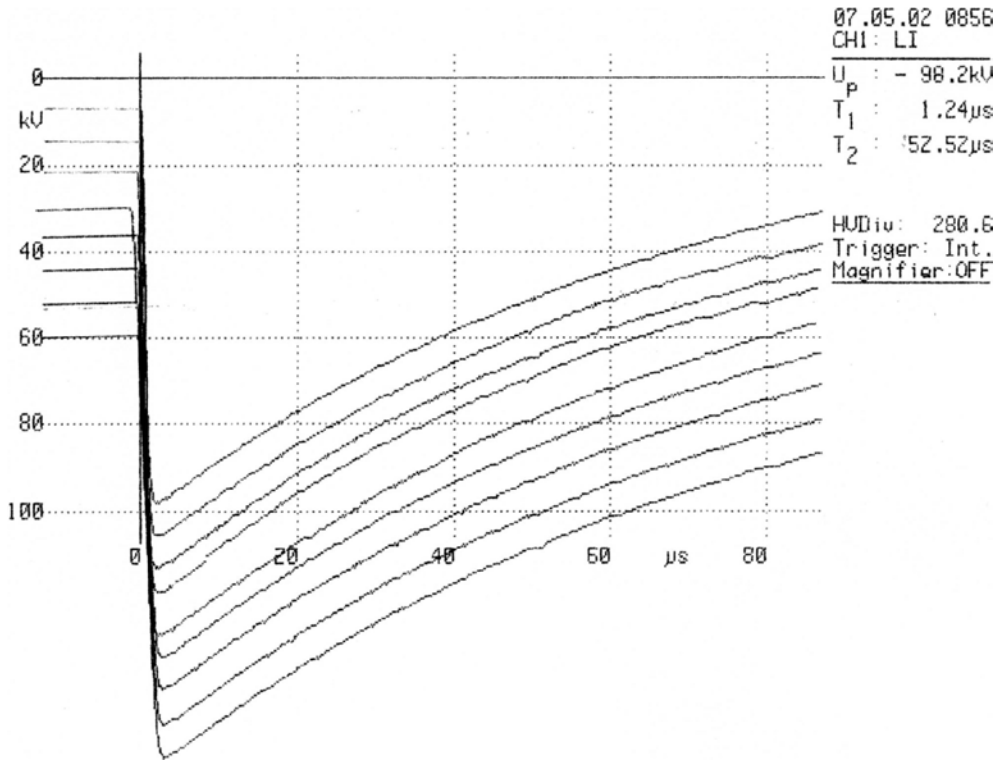
Phase 2 negative impulses





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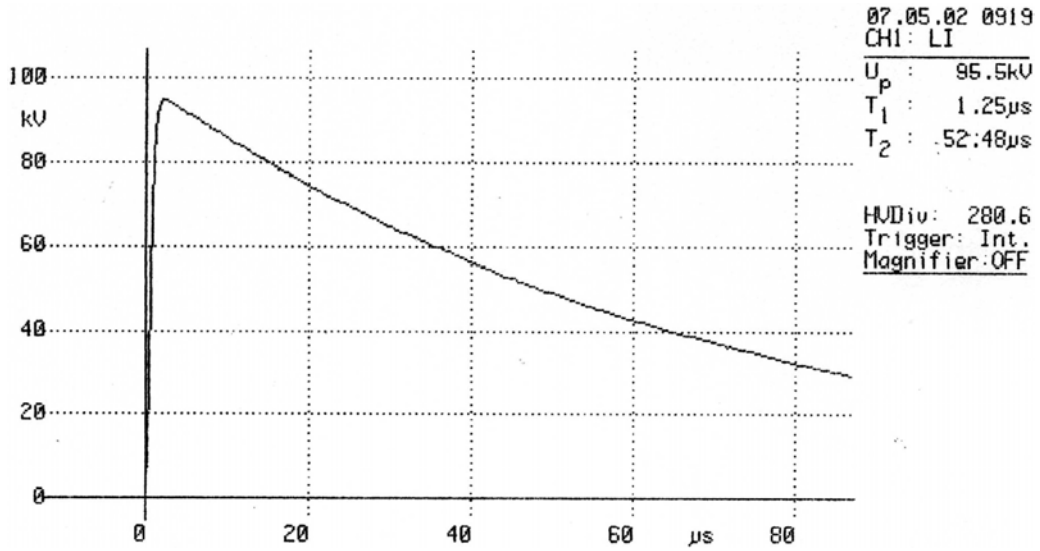
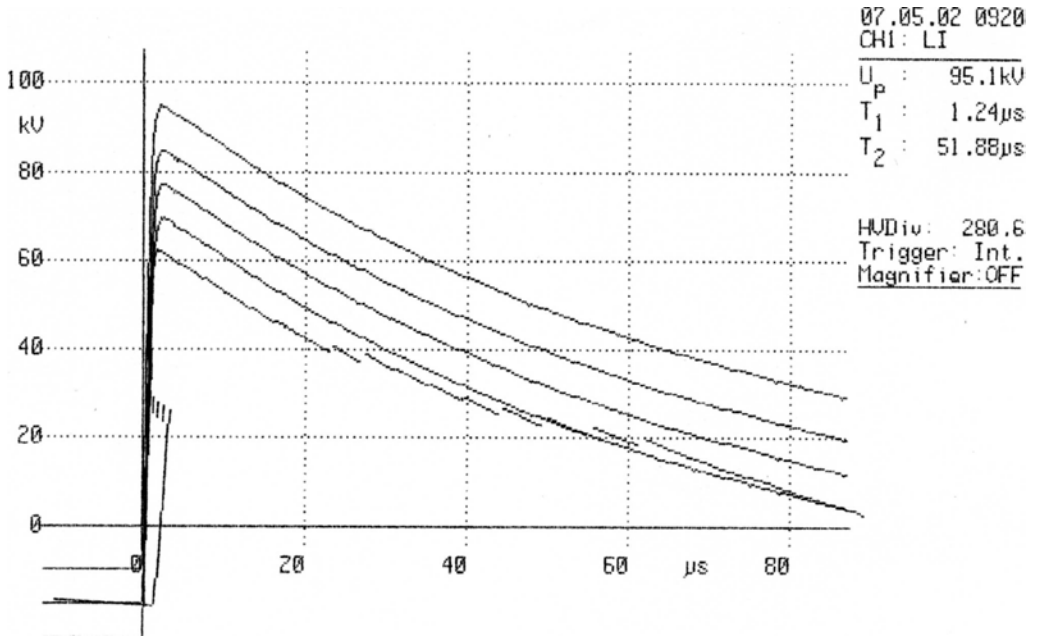
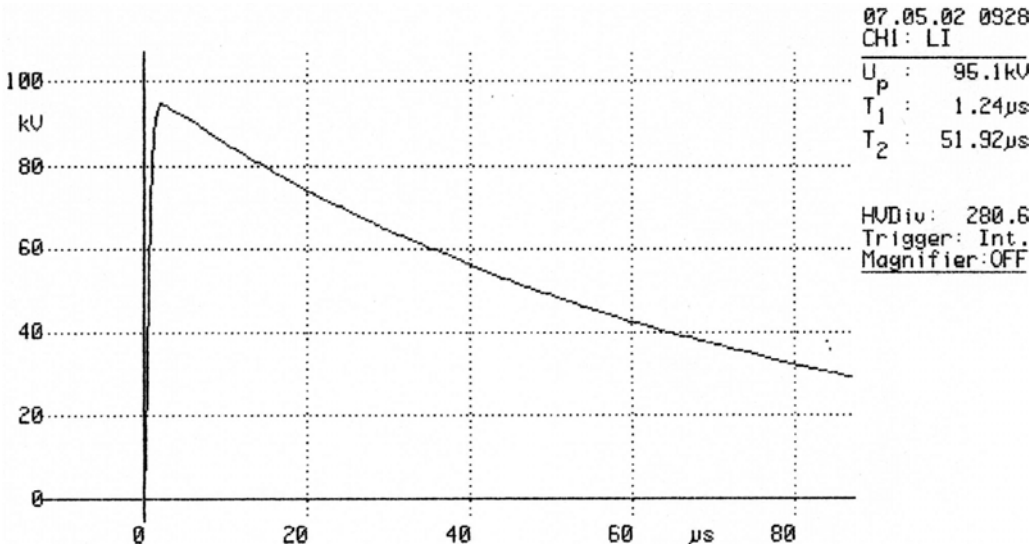
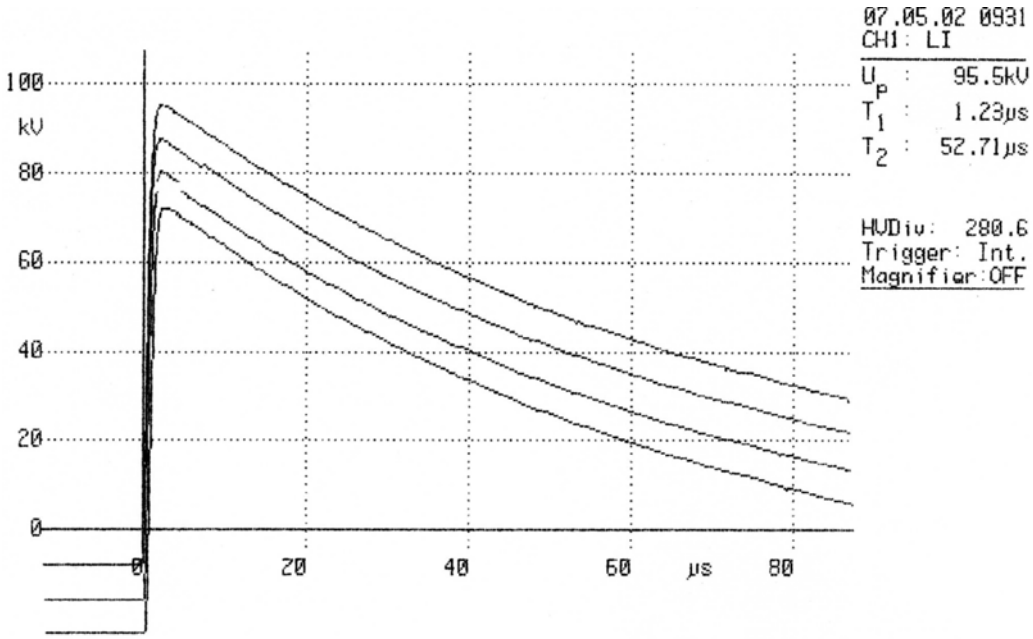
Phase 3 positive impulses









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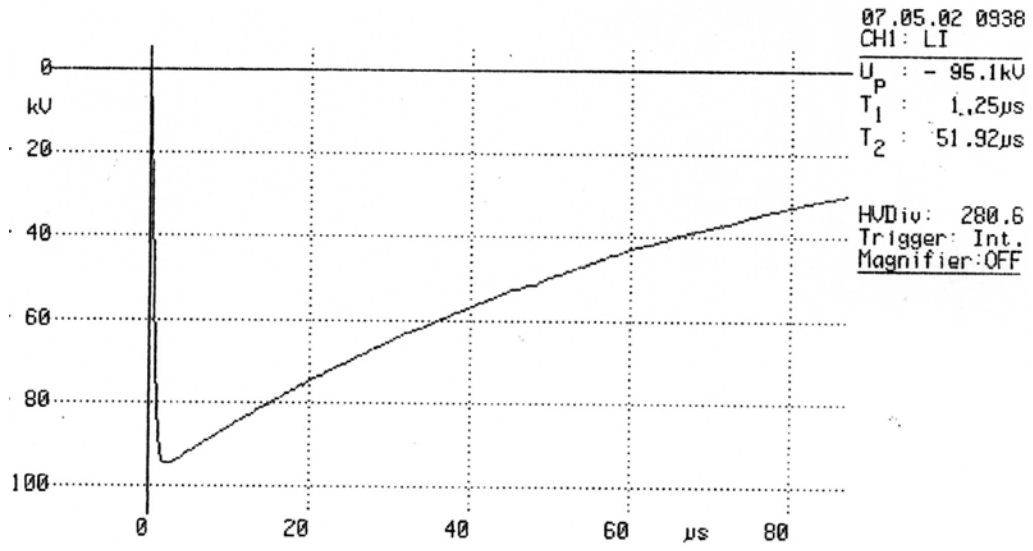
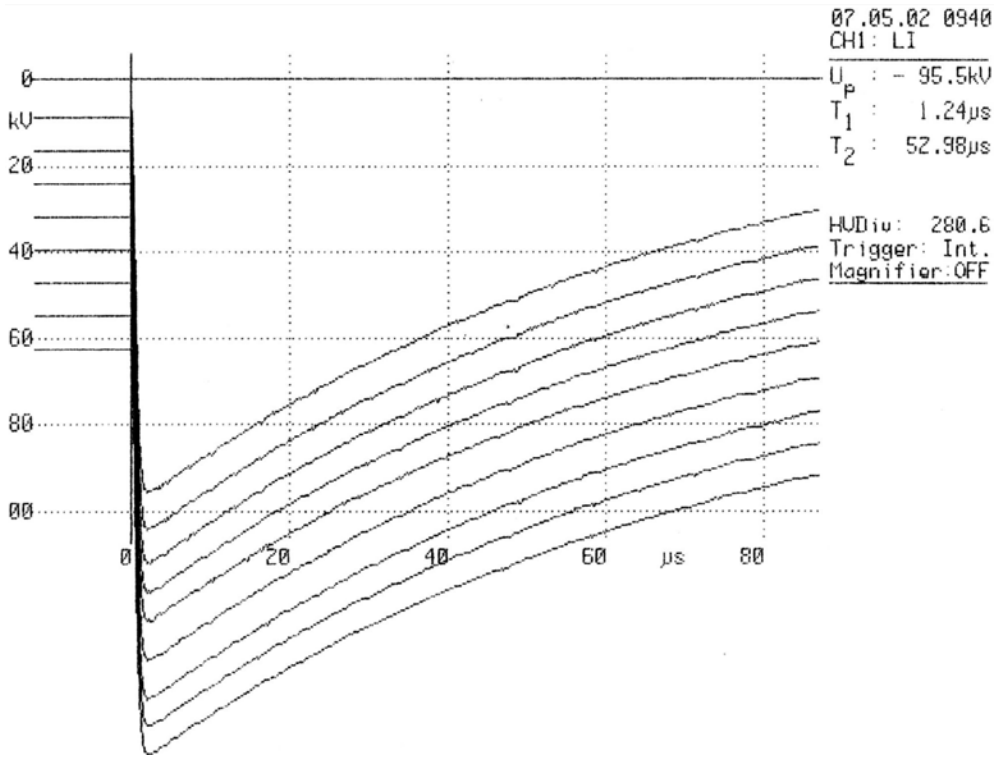
Phase 3 negative impulses





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2.12 AC Voltage Dry Withstand Test

For each phase the voltage was increased from 0 to 16 kV and maintained for 15 minutes. The screen was connected to earth potential. The test was made in air at ambient temperature.

Requirement : no breakdown or flashover

	at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	16 kVAC/15 min.	passed
2	16 kVAC/15 min.	passed
3	16 kVAC/15 min.	passed

Used Equipment : 3M No. 71745

2.13 Impact Test at ambient temperature

Conducted under equal conditions and requirements as described under 2.4 but the falling height of the block was 3 m instead of 1 m.

Requirement : Insulation resistance between conductors and metallic screen > 50 mΩ

	Resistance at ambient temperature ϑ_a = 23°C	
Phase to screen	Prior impact	After impact
1	> 10 000 MΩ	> 10 000 MΩ
2	> 10 000 MΩ	> 10 000 MΩ
3	> 10 000 MΩ	> 10 000 MΩ

2.14 AC Voltage Dry Withstand Test

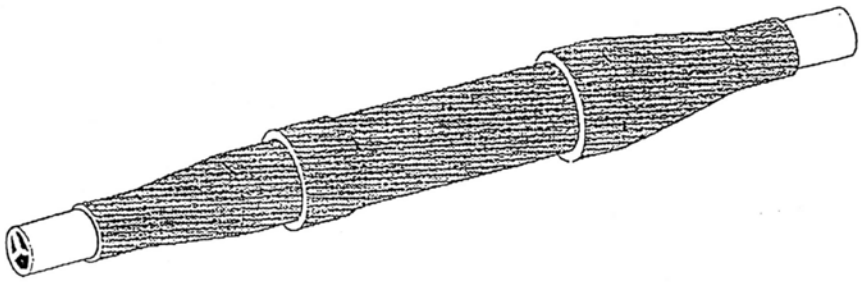
For each phase the voltage was increased from 0 to 16 kV and maintained for 15 minutes. The screen was connected to earth potential. The test was made in air at ambient temperature.

Requirement : no breakdown or flashover

	at ambient temperature ϑ_a = 23°C	
Phase	conditions	result
1	16 kVAC/15 min.	passed
2	16 kVAC/15 min.	passed
3	16 kVAC/15 min.	passed

Used Equipment : 3M No. 71745

3M QS 1000



Kit no.	Diameter over Primary Insulation Ⓔ (mm)	Cross Section (mm²)	Diameter over Connector (mm)	Connector Length max. (mm)
92-AG610-3	17,7 - 26,0	70 – 120	14,2 - 28,0	135
92-AG620-3	22,3 - 33,2	150 – 300	18,0 - 33,2	145

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ISSUE: 1 ISSUE DATE: 21.12.1999

ALL STATEMENTS, TECHNICAL INFORMATION AND RECOMMENDATIONS CONTAINED HEREIN ARE BASED ON TESTS WE BELIEVE TO BE RELIABLE HOWEVER, SINCE THE CONDITION OF USE AND THE APPLICATION ARE BEYOND OUR CONTROL THE PURCHASER IS RESPONSIBLE FOR THE PERFORMANCE OF THE SPLICES AND TERMINATIONS MADE IN CONNECTION WITH THE USE OF DATA OR SUGGESTIONS HEREIN.

ID-0212-2647-0

DES ENG.	S. Cakle	1. ISSUE DATE 21.12.99
MOD ENG.		1. CHANGE DATE:
DRAWN	M. Hubrich	2. CHANGE DATE:
CHECKED	D. Hallbusch	3. CHANGE DATE:
RELEASED	A. Klink	4. CHANGE DATE:

3M QS 1000

INLINE SPLICE

92 - AG 610 – 3 TO 92 - AG 620 – 3
(ADWEA)
with cold shrink rejacketing for polymeric 3-core cable with copper conductor, copper tape shield and armour

acc to VDE 0273 (IEC 502-1) 8.7/15 (17.5) kV

3M ELECTRICAL PRODUCTS

XE 0091-2647-7

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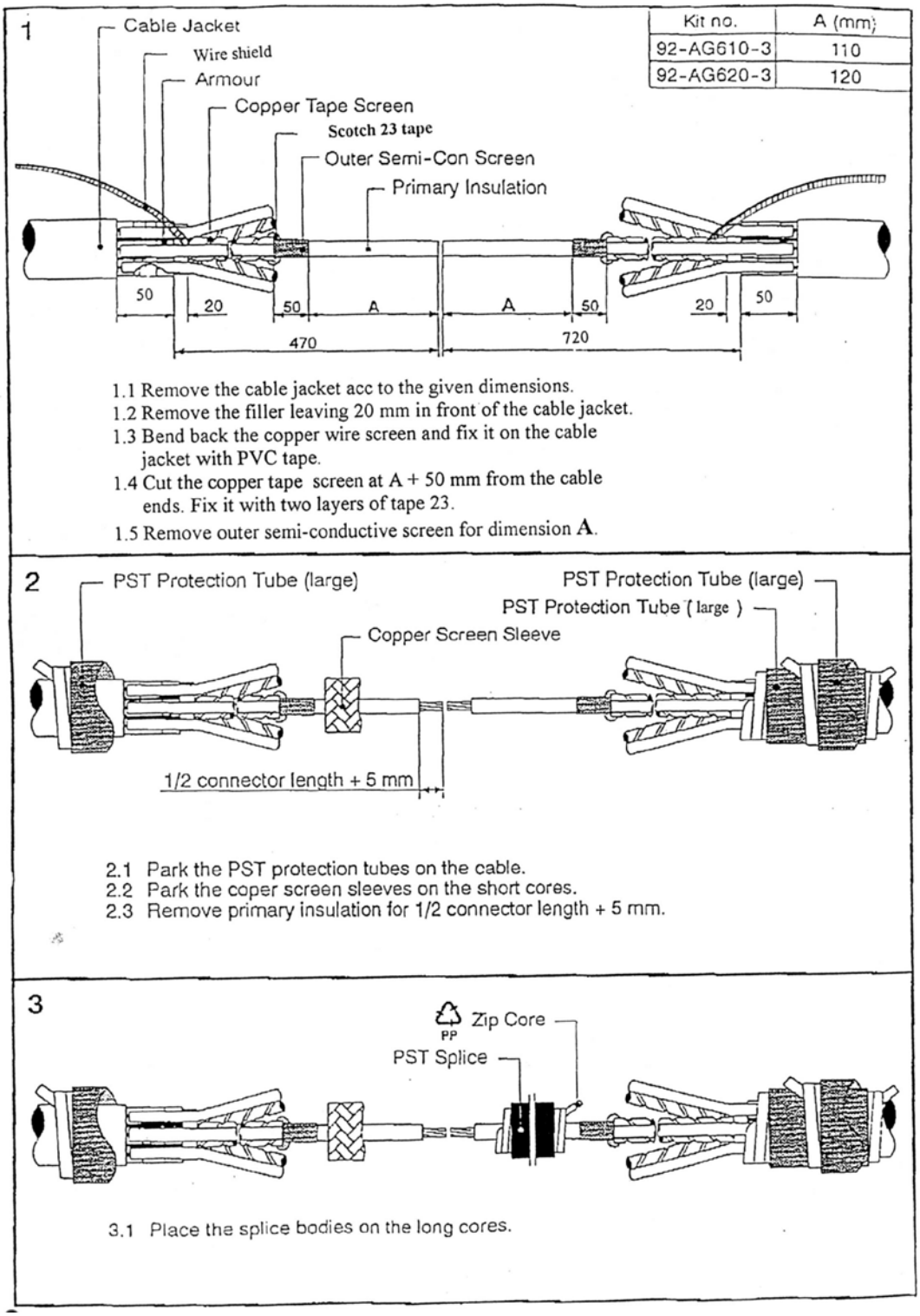

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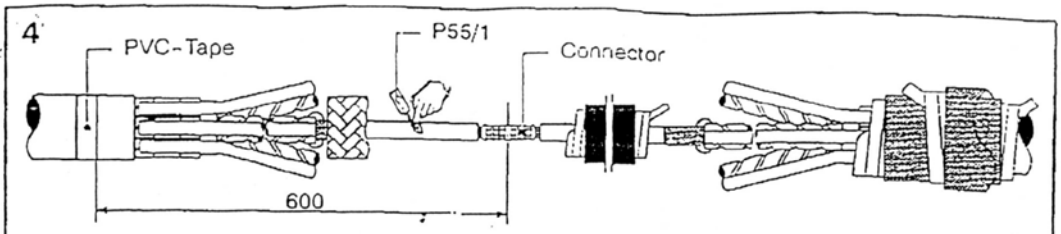
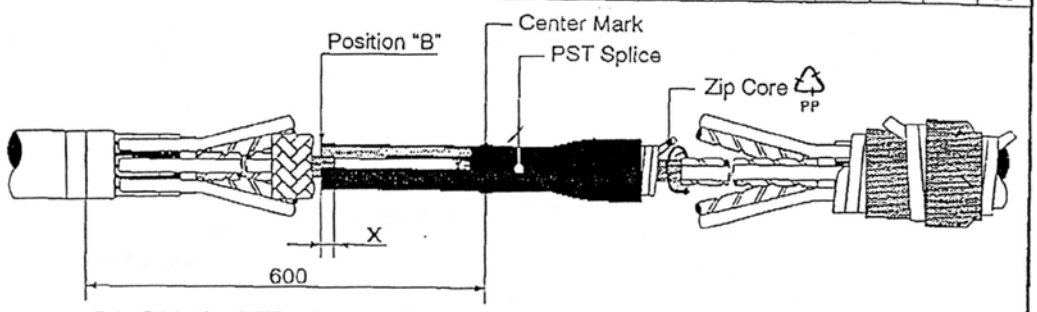


4.1 Install the connector acc supplier definition. Remove excess grease, smooth and clean the connector.
4.2 Apply a PVC-tape onto the cable jacket at a distance of 600 mm to the connector center.
4.3 Lubricate the ends of the semi-conductive screen, the primary insulation and the connector with P55/1. Use the plastic gloves provided.

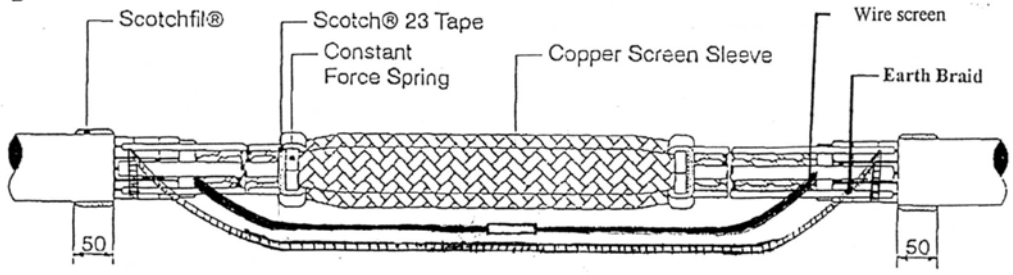
5

mm^2	70	95	120	150		185	240	300
X (mm)	45	40	35	30	40	35	30	30



5.1 Slide the PST splice over the connection up to position "B".
5.2 Shrink the PST splice into position by pulling out and unwinding the core in counter clockwise direction.
5.3 After shrinking, ensure the symmetrical position of the PST splice acc to gauge 600 mm, otherwise make correction by displacement.

6



6.1 Slide the copper screen sleeve over the splice and fix it by means of constant force springs on the metallic screen. Cut of the remaining wires of the sleeve.
6.2 Overwrap the constant force springs with two half-lapped layers of Scotch® 23 tape.
6.3 Apply two layers of Scotchfil® onto the cable jacket acc to given dimensions.
6.4 Crimp each wire screen separately with a connector; connect the earth braid with the armour at both sides.

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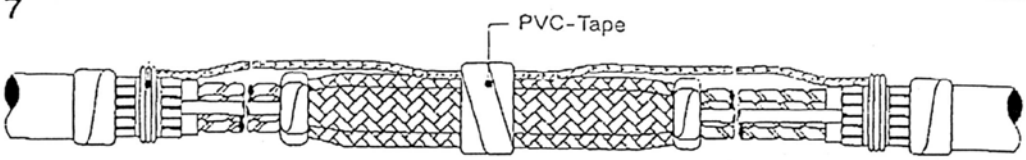
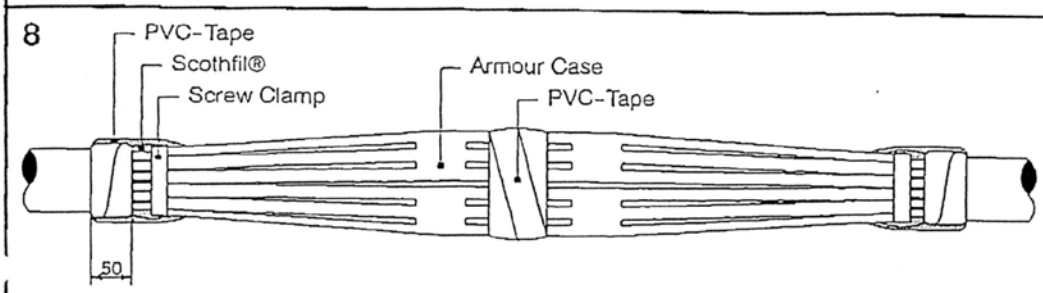
7



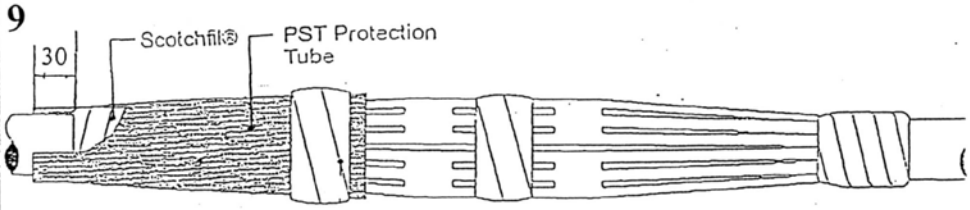
7-1 Push the 3-core-s, the wireshield and the earth braid tight together and overwrap the center of the joint with one half lapped layer of PVC-tape.

8



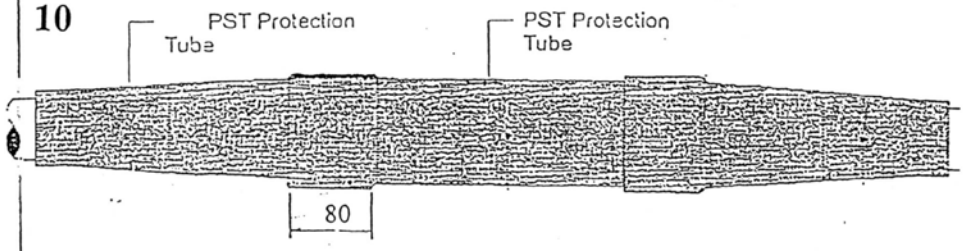
8.1 Wrap the Armour Case around the joint and fix it on the armour with the screw clamps. Fill the irregularuties of screw clamp with Scotchfil® and cover it with some layers of PVC-tape.
8.2 Overwrap the center of Armour Case with two half lapped layers of PVC-tape.

9



9.1 Shrink down the PST protection tube, starting 30 mm in front of the PVC tape.
9.2 Apply 3 layers of Scotchfil 10 mm from the end of the protection tube.

10



10.1 Shrink down the 2nd PST protection tube starting 80 mm on the first protection tube.
10.2 Repeat steps 9.2 and 1 0.1 for the 3rd PST protection tube.

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